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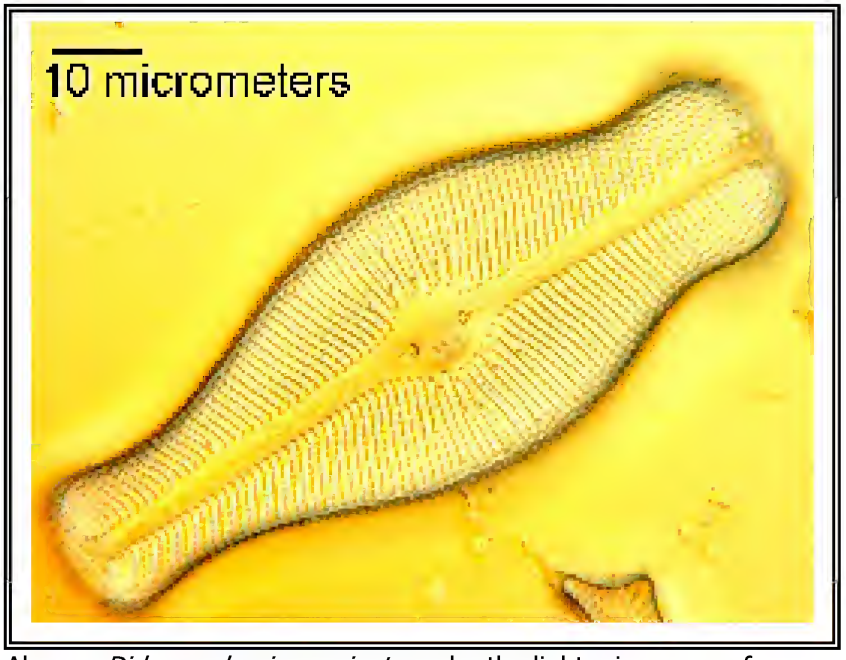
Didymo Alert

October is not too late for pursuing plants in the wild, particularly if you are headed to western Wyoming rivers. A native freshwater alga, the diatom *Didymosphenia geminata* ("Didymo"), recently made headlines when it was discovered in Lake Creek of the Snake River watershed (Casper Star Tribune; 29 Sept 2007), among the few verified records in the state (all in the Greater Yellowstone). --Why all the ruckus?

- Didymo is the only freshwater diatom to exhibit a puzzling invasive behavior, it is expanding its distribution, and is becoming a problem around the world.
- Didymo thrives in nutrient-poor streams, yet has the capacity for exponential growth, a significant biological impact to stream ecosystem function and associated coldwater fisheries.

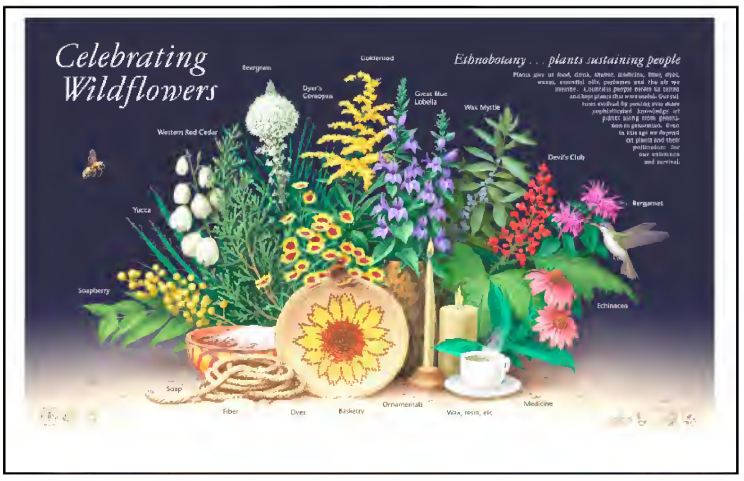


Above: *Didymosphenia geminata* under the light microscope; from Spaulding and Elwell (2007; see posting below)

- Didymo produces mucopolysaccaride stalks that form solid mats over the river bed, which appear to be resistant to biodegradation by bacteria and fungi.

For photographs and descriptions of this mat-forming species, and for associated links, see the EPA *Didymosphenia* posting (http://www.epa.gov/Region8/water/didymosphenia/), and the EPA white paper - Increase in nuisance blooms and geographic expansion of the freshwater diatom *Didymosphenia geminata*: Recommendations for response (Spaulding and Elwell 2007). Please report suspected mats of *Didymosphenia geminata* by collecting a small sample (put a pinch of the material in a vial or in a folded business card). Label samples with the date, latitude and longitude (or accurate site information). Send reports and samples to: Sarah Spaulding, Ph.D. EPA Region 8, 1595 Wynkoop St., Denver, CO 80202-1129.

WNPS News



Plants on Display: Look for the handsome new "Celebrating Wildflowers" poster above that focuses on plant uses and ethnobotany. For over a decade, there have been educational materials printed nationally with a celebrating wildflowers theme, but copies not available to the public in Wyoming.

The current poster, printed by BLM, features eleven widely-used plants and associated products; seven of which are native to our state. Wyoming Native Plant Society is teeming up with BLM and other agency partners to help distribute copies. County libraries have already received copies and information that might be used for setting up spring displays. Wyoming teachers were able to get copies at a statewide Wyoming teachers conference held last month in Casper.

Poster copies are becoming available in all ten BLM offices of Wyoming. Members in Laramie can also get poster copies through the University of Wyoming - Department of Botany. A handout is also available with information on the seven "Wyoming natives" that are part of the poster, and providing additional information sources. If you are out-of-state and would like to order a poster , contact your nearest BLM office, or if there are none, request WNPS copies (bheidel@uwyo.edu).

While states are jostling to be first in line for presidential primaries, and the federal fiscal year of 2008 has already started, the official start of the 2007 membership year and Board terms for Wyoming Native Plant Society began in July 2007. For those people still in the 2006 membership year – please renew!

Wyoming Native Plant Society (WNPS) is diversely composed of afficionados and professionals, students and educators, private industry and public agencies, backyard naturalists and backcountry trekkers. How can WNPS foster and integrate such a corresponding spectrum of interests? For a piece of insight, read the "Botanical Electronic Newsletter" (May 2007) book review of a recent publication that includes a chapter on the future of native plant societies: http://www.ou.edu/cas/botany-micro/ben/; or the book itself: Krupnick, Gary A. and W. John Kress. 2005. *Plant Conservation: A Natural History Approach*. University of Chicago Press, Chicago. 346 p. Extracts from this article will appear in future issues, with invitations for your reactions!

WNPS Markow Scholarship: The 2008 WNPS Markow Scholarship announcement will be in the December issue. The deadline will be in February.

Wyoming Native Plant Society
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WNPS Board – 2007

President: Beth Burkhart '07	605-673-3159
Vice President: Lynn Moore '07	472-3603
Sec.-Treasurer: Ann Boelter '07	745-5487
Board Members: Dave Scott '07-'08	690-1683
Curtis Haderlie '06-'07	690-4381

Call for Candidates: A 2008 nomination committee will be established to fill officer positions and the Board position up for renewal next year. Interested? Contact Beth Burkhart (baburkhart@fs.fed.us).

Newsletter Editor: Bonnie Heidel (Laramie; bheidel@uwyo.edu)
Teton Chapter: PO Box 82, Wilson, WY 83014 (Joan Lucas, Treasurer)
Bighorn Native Plant Society: PO Box 21, Big Horn, WY 82833 (Jean Daly, Treasurer)
Webmaster: Melanie Arnett (arnett@uwyo.edu)

Contributors to this issue: Bonnie Heidel, Martin Lenz, and Dave Scott; and graphics contributed by Walter Fertig, Curtis Haderlie and Joan Lucas.

Treasurer's Report: Balance as of 27 Sept 2007 - General Fund: $1,250.53; Markow Scholarship Fund: $991.00. Total Funds: $2,241.53

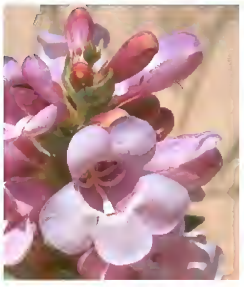
2007 Annual Meeting Highlights

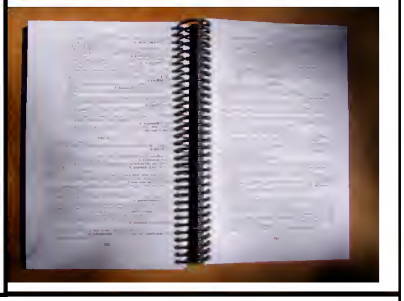
The 2007 WNPS Annual Meeting, held June 15-16 outside of Casper, offered two full days of adventure. Fieldtrips were lead by George Jones and George Soehn exploring the ecology of the Shirley Basin and Casper Mountain area (on Saturday), and by Frank Blomquist and Bonnie Heidel trekking to see blowout penstemon and the Ferris Dunes (on Friday). Lynn Moore coordinated all of the tours and publicity.
– THANK YOU to all who came!

Left: George Jones and Robert Dorn (lower right and standing, respectively) spark the interest of budding scientists. Photo by Curtis Haderlie.

Below: Curtis Haderlie sets tracks across blowouts near blowout penstemon. Photo by Joan Lucas.

Blowout penstemon (*Penstemon haydenii*; upper right) greeted dune visitors in full bloom. Photo above by Joan Lucas.





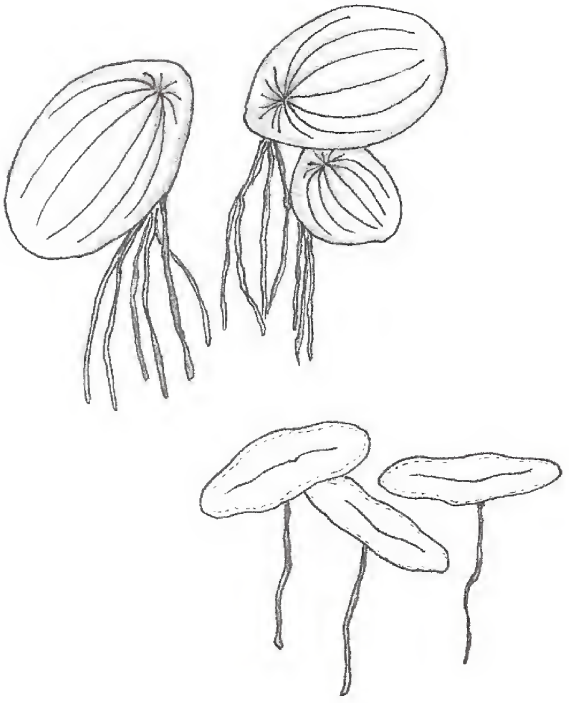
Annual meetings offer unexpected ways to learn from one another, and 2007 was no exception. Here is a tip from a Casper member, who added not only protective plastic lamination to her copy of *Vascular Plants of Wyoming* (Dorn 2001) but also put it into spiral binding so that it can be laid flat and pages turned with one hand. A replication of this at the University of Wyoming Copy Center (above) cost $3.18 – extending the shelf-life and-field-life of this critical reference for years. Photos by Bonnie Heidel.

Wyoming Duckweeds

By Dave Scott

An interesting group of aquatic plants is found in the still waters of this state. Members of the genus *Lemna* within the monocot family *Lemnaceae* can be seen as bright green mats floating on the surface of water in the summer. In the same family, we have a single exemplar from the genus *Spirodela*, where these plants are typically found in less dense populations. Our *Spirodela polyrhiza* may also be commonly called Duck-meal and can be distinguished by having multiple roots per frond, versus a single root in *Lemna*. With the exception of *Lemna trisulca*, Wyoming duckweeds do not grow beyond about 6 mm in length. These plants are tiny. They are known as the smallest flowering plants in the world (Landolt 1986) and this leads to identification problems, but enigmatic classification schemes coupled with unusual aquatic life histories makes duckweed ecology very fascinating in our otherwise dry environment.

Wyoming duckweeds rarely flower so if you have seen this condition, you're probably using a good dissecting microscope and have collected extensively. Reproduction instead is by a vegetative method of "frond" subdivision. In the family, leaves are referred to as "fronds" because they actually contain elements of stem tissue (Landolt 2000). Frond subdivision occurs in tiny pouches on the margin of the mother frond and may produce daughter fronds at a very fast rate. The result is the clonal nature of most duckweed populations – the (for our purposes) identical genetic makeup between and among individuals. How then do the tiniest flowering plants sustain their populations from year to year while only rarely flowering and producing seed? Turion production can compensate for overwinter mortality of some duckweeds. The life history event of turion production is



Above: *Spirodela polyrhiza* (top) and *Lemna valdiviana* (below). Illustrations by Walter Fertig.

analogous to mother/daughter frond subdivision. A frond simply asexually produces a starch-rich granule called a turion, which then sinks to the bottom of the water body. There, the conditions for overwintering are more favorable and as shown in *Spirodela polyrhiza*, a constant light trigger sometime in spring allows turion germination to produce floating fronds of the summer season (Appenroth and Gabrys 2001). Our *Lemna turionifera* and *Spirodela polyrhiza* follow this pattern.

It may be true that some of the bigger duckweed populations are sustained by flowering and seed production, merely by the notion that a larger habitat will support a larger population, and thus a greater chance for seed production to occur somewhere within that population. This brings us to yet another fun observation which is that waterfowl move

(Continued on p. 5)

(*Wyoming Duckweeds*, continued from p. 4)

duckweeds when the plants adhere to their feet, thus effecting the constant introduction of distant populations to new locales. The result gives range distributions of duckweeds that are very hard to track (Landolt 2000). They are essentially "moving targets" since an established summer population may or may not overwinter. Thermal springs in Wyoming may provide year-round habitat for duckweeds, but this needs to be examined in detail.

Keep an eye out for *Spirodela polyrhiza* if you are in northwest Wyoming. It was first collected in Wyoming in Carbon County (RM database) and has recently been discovered at many locations in Teton County (Scott 2007). Also likely to exist in the state is *Lemna gibba* (Dorn 2001, Scott 2007). Get out a pair of rubber boots, and some shallow water wading might reveal our smallest species, *Lemna minuta* and the common but morphologically distinct *Lemna trisulca*.

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ANNOTATED COUNTY CHECKLIST OF THE MOSSES OF WYOMING NOW ONLINE

By Martin Lenz

Patricia Eckel of the Missouri Botanical Garden, who published the "Synopsis of the mosses of Wyoming" in 1996, has recently placed online her "County checklist of the mosses of Wyoming". This work is a compilation of the specimens examined in the preparation of the former publication and contains not only the county-level distribution information for each taxon, but label data such as location information, habitat information, and the collector name, number and repository, as well as a number of notes made by the author at the time of the study. It covers most, if not all, of the 315 moss taxa recognized in the Wyoming flora through 1996 and will serve as a springboard for further floristic work in the state, as well as a foundation for the future development of a list of bryophytes of potential concern for Wyoming.

This information represents Ms. Eckel's data and notes from that time that are generously being made available for the use of current and future workers and enthusiasts concerned with bryophytes in the state. She points out that the list "is presented "as is," that is, without revision from a version prepared some 12 years ago". In making use of the information, it must be remembered that many nomenclatural changes have occurred and much new information has accumulated since that time. However, it constitutes a very big first step toward documenting the distribution of bryophyte species in Wyoming.

This work may be accessed through Res Botanica, a Missouri Botanical Garden Web Site, at http://www.mobot.org/plantscience/resbot/ , or more directly at http://www.mobot.org/plantscience/resbot/Bryo/WyomingCountyChecklist.htm . (120 pp.) ML

Noteworthy Collections

One Good Quest After Another

By Bonnie Heidel

Western bladderpod (*Lesquerella multiceps*) was first collected in Wyoming by Edwin Payson and George Armstrong on July 11, 1923 at Sheep Mountain (now called Ferry Mountain; in the Snake River Range of Lincoln County; *Payson and Armstrong 3466* RM). The collectors reported it as "common" on "stony upper slopes" and originally identified it as *L. utahensis* (not previously known from Wyoming).

One can only imagine Payson's excitement. He published a monograph on *Lesquerella* only two years earlier in which he stated:

> "*Lesquerella utahensis* is perhaps the most interesting of all the species of *Lesquerella* because of the great similarity, in some of its forms particularly, to members of the genus *Physaria*. So striking, indeed, is this similarity that one is a little perplexed at times to know to which genus a given plant should be referred. And yet *utahensis* as a species is not entirely satisfactory, so close is it to other forms that give no suggestions of *Physaria*..." (Payson 1921)

The Payson treatise on *Lesquerella* greatly revised the prior 1888 treatment of the genus by Sereno Watson, incorporating many species like *L. utahensis* that were unknown to the earlier author. The Payson monograph also proposed a far-sighted theory of phylogeny followed by later authors. The Payson collection of *Lesquerella* from Ferry Peak was later annotated to *L. multiceps*, a new species described by Bassett Maguire (1942), splitting the *L. utahensis/L. kingii* complex with its geographic forms into separate species.

Some decades later, a second *Lesquerella* collection was made in Lincoln County that was identified as *L. multiceps* (*Cronin s.n.* UTC), a flowering specimen from the Bear River Divide in the Overthrust Belt. The Bear River Divide area was recently revisited and surveyed, and material collected with mature fruits that represented a new county record for the closely-related Prostrate bladderpod (*Lesquerella prostrata;* Heidel 2005), a species that has pods which are longer than wide.

Above: A search for Jones' columbine (*Aquilegia jonesii*) led to a wild *Lesquerella* chase. Photo by Joan Lucas.

After all this time, the status of *L. multiceps* in Wyoming still hinged on the 1923 collection of Payson and Armstrong. Had anyone visited Ferry Peak in the intervening 84 years? My ears perked when Joan Lucas, an avid hiker and intrepid Wyoming Native Plant Society member reported seeing Jones' columbine (*Aquilegia jonesii*) on Ferry Peak recently, representing a new Lincoln County record that she wanted to revisit and document this year. "Keep bladderpods on your radar screen" I begged her. She and Curtis Haderlie ascended Ferry Peak on June 10 before thunder clouds rolled in, returning with the specimen and photographic proof of *Aquilegia jonesii* in full glory. *Aquilegia jonesii* also occurs in Montana. The Ferry Peak locale appears to represent the only known location for this species west of the Continental Divide. En route, they collected and photographed bright bladderpods that Joan thought **couldn't** be the *Lesquerella multiceps* because they were so abundant.

At this point, I asked Joan if she would consider a second Ferry Peak ascent in one year. Without hesitation, she agreed to another 3500 ft scramble in my company. (Continued on p. 7)

(*One Good Quest After Another* – cont. from p. 6)

Above: Western bladderpod (*Lesquerella multiceps*) in flower. Photo by Joan Lucas.

Below: Joan Lucas among Jones' columbine. Photo by Curtis Haderlie.

We made the Ferry Peak climb on July 10, 2007 and were greeted by *Lesquerella multiceps* within moments of reaching the limestone ridge line, finding a bladderpod with globose fruits on an upwardly sigmoid-curved pedicel (*Heidel* and *Lucas 2946* RM).

In fact, we found that *Lesquerella multiceps* spans two miles of ridgeline, with areas of high density. It is the quintessential peripheral species in the Wyoming flora, occurring so close to the Idaho state line that a determined crow could fly upwind from the ridge to the state line in minutes.

Lesquerella multiceps is reported as locally common in a wide range of habitats in the Bear River Range of Idaho (Mancuso 2003), and the confluent Bear River Range of Utah (parts of a 4-county area including Bear Lake and Franklin counties, Idaho; and Cache and Rich counties, Utah). It remains on the Wyoming plant species of concern list because its entire range of distribution is limited, there is only one discrete place known for it in the state, and this is the only known occurrence outside the Bear River Range. The Ferry Peak population (Wyoming) and almost all Idaho populations are on the Caribou-Targhee National Forest, where they have few if any immediate threats.

There are no longer Snake River ferries to be viewed from Ferry Peak near Alpine, Wyoming. But we can still walk (and scramble) in the footsteps of great botanists to see Wyoming botanical wonders.

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The July visit was made incidental to Targhee National Forest surveys for two sensitive species, in a joint project of the Caribou-Targhee National Forest and the Wyoming Natural Diversity Database.

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Botanist's Bookshelf

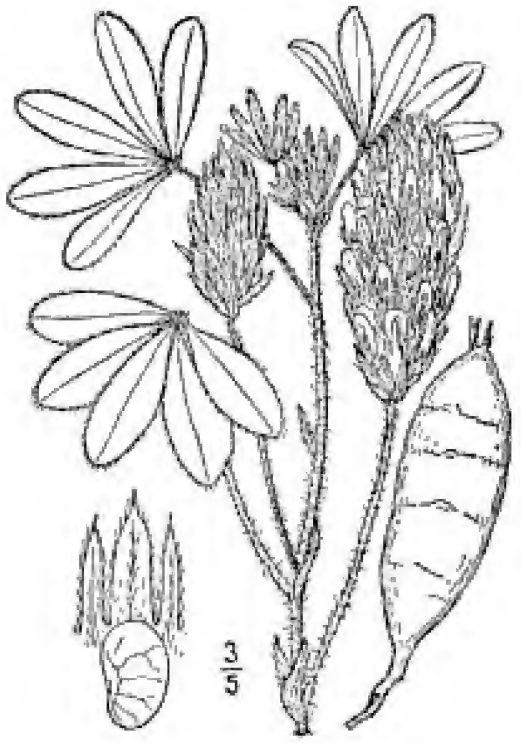
A Taste of Heritage: Crow Indian Recipes and Herbal Medicines By Alma Hogan Snell. 2006. Edited by Lisa Castle. 191 pp. University of Nebraska Press, Lincoln, NE 68588-0630. Paperback. $17.95 plus postage, available at: www.bisonbooks.com .

Review by Bonnie Heidel

A Taste of Heritage is a literary and culinary feast of native plants as main courses in cultural continuity. Alma Snell is a gracious hostess for the feast, as though the reader were personally invited over for dinner. However, Alma Snell's book, her kitchen, and her experiences have no equal. The author knows plants of the northern Rockies and high plains and is a Crow elder in her 80's, raised by her Grandmother, a medicine woman, and by her Grandfather. She roamed the foothills of the Big Horn Mountains around Crow Agency with her Grandmother - digging roots, picking berries and other fruits.

Snell writes as "keeper of the lodge," tending to the diet and well-being of immediate and extended family. It is particularly poignant to read this book as the third in a cultural trilogy spanning over 140 years. Her Grandmother was "Pretty Shield," who lived through the transition from nomadic life to reservation life. Pretty Shield was interviewed by Frank Linderman, and her biography is presented in *Pretty-shield: Medicine Woman of the Crows* (Linderman 1932). This was followed many years later by Alma Snell's autobiography *Grandmother's Grandchild: My Crow Indian Life* (Snell 2000). The cultural continuity manifested in plant uses is expressed most fully in *A Taste of Heritage* (Snell 2006).

The *Taste* is served up with commentary on changes in tradition and adaptations. The traditional wooden digging



Above: Prairie turnip (or breadroot; *Pediomelum esculentum*).
From: Britton, N.L., and A. Brown. 1913. *Illustrated flora of the northern states and Canada*. Vol. 2: 363. Courtesy of Kentucky Native Plant Society. Scanned by Omnitek Inc. Usage Requirements.

stick of Pretty Shield, used for digging "prairie turnips" (*Pediomelum esculentum*), gave way to a wrought iron tool when such metals became available to her Grandmother. More recently, Alma Snell integrates food processors and Tupperware with the native flora in ways that might take people in the culinary arts and botanical science by surprise.

Yes, it is a cookbook, with at least 64 native plant species represented in one or more uses (not to mention over 20 ways of preparing buffalo). It also has chapters on plant uses for medicine and beauty products. Most plant species are cited by common names in English and in Crow, sometimes the translation of the Crow name is included (can you guess which plant is called "slick bears'

(Continued on p. 9)

(*A Taste of Heritage* – continued from p. 8)

eyes" in Crow?), and all are cross-referenced by scientific name. The harvest procedures are often presented. Non-native plants and animals that made their way into her family's diet are incorporated (e.g., pheasant, burdock, apples and wheat; including the not-so-mysterious origins of Indian frybread). What is more, this is also a story book, cultural commentary and autobiographical extension.

Can you envision living on wild plants? *A Taste of Heritage* is food for thought, even if there are limited graphics. The photo to left shows prairie turnip (*Pediomelum esculentum*) in stages of being sorted, skinned and sliced. It is NOT part of the book. Instead, it was taken one day in the author's yard. Photo by B. Heidel

While the *Taste* includes recipe measurements and some harvest methods for edible plants, it is deliberately vague in providing details on medicinal plant uses, and is accompanied by all appropriate disclaimers. The use of milkweeds (*Asclepias* spp.) for treatment of arthritis might hold promise in medical research, as would be suggested by the author's success stories. However, the cardiac glycosides in milkweeds and incompleteness of information on their use are reasons for caution before any indiscriminate use of them is considered by the public.

A Taste of Heritage is written with the editorial support of Lisa Castle, a graduate student working on a doctorate in biology at the University of Kansas, and the botanical collaboration of Kelly Kindscher (Kindscher 1987, 1992). The illustrations are black and white photographs of select plants taken by the editor, and the only color is on the cover. Despite the editorial process and the author's interactions with botanists (including this reviewer), the voice of the author comes through clearly and unencumbered. The far-flung range of topics is never dull despite the fixed structure throughout the book, organized into chapters by use and then by plant.

This book has a place at home (kitchens and reading rooms), camps, and libraries. It does not divulge cultural trade secrets but provides a foundation of understanding for many audiences that potentially include tribal and intertribal audiences. For the scientific audience, it complements and personalizes the encyclopedic approaches of Kindscher (1987, 1992) and Harrington (1967).

Snell is regarded by some as an ethnobotanist (which is usually reserved for people in academic institutions who study cultures outside their own), herbalist (which is sometimes applied to people who are in unlicensed realms of plant use), teacher, and story-teller. She graduated from Indian boarding schools in Flandreau and Pierre, SD and worked as cook in many capacities. Fortunately, the author and her book defy pigeon-holing. If there is one weakness, it might be in the book title, one that gives little inkling of the feast inside.

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Noteworthy Collections

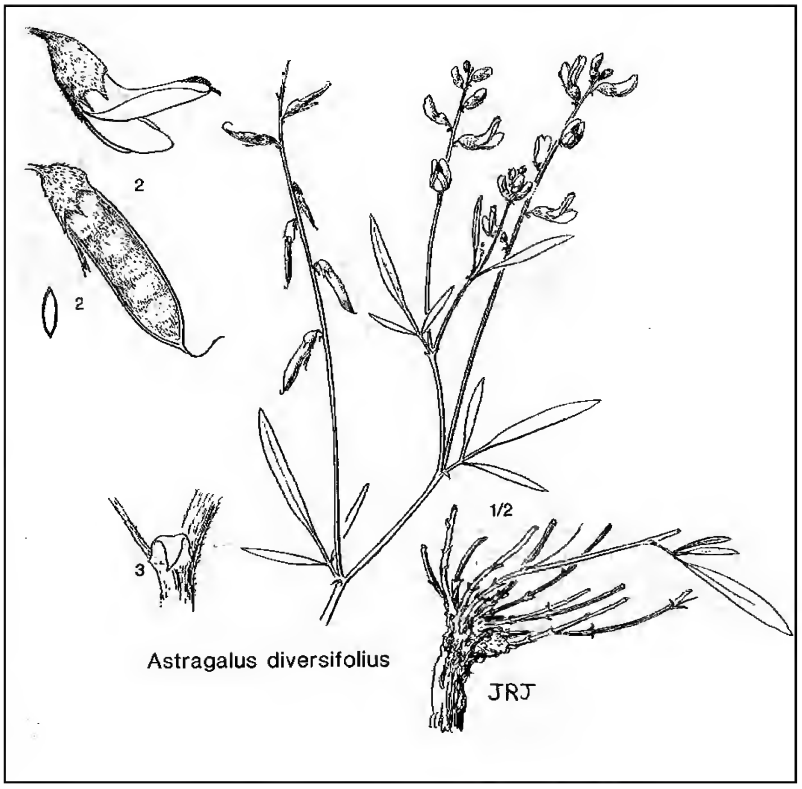
Playa Plants

By Bonnie Heidel

Chain Lakes was the site of four noteworthy collections in 2007, including rediscovery of *Astragalus diversifolius* (meadow milkvetch). Chain Lakes lie at the lowest elevations of the Great Divide Basin, part of the Red Desert on the Continental Divide of southwestern Wyoming.

Alkaline lakes are in the center of the Basin, surrounded by extensive playa landscapes with unique habitats that support the four species. Giant silt dunes march downwind from alkali lakes, and low, gently-rolling silt dunes run like eastbound waves beyond. Across large areas, nuances of groundwater movement and salt migration create a stark mosaic of luxuriant meadow patches perched above barren salt flat pockets. Mounds reported by the Hayden Expedition as "mud-springs" rise 1-5 m above this landscape (Dorn 1986), and there are low-lying "bentonite boils" with pots of silt soup. At margins and transitions of this playa landscape are alkaline meadows made up of salt-tolerant plants.

Meadow milkvetch (*Astragalus diversifolius*) was collected this past summer in alkaline meadows about 15 miles apart at far ends of Chain Lakes (*Heidel 2935, 2939* RM). It was previously collected by Thomas Nuttall in 1834 in the "Colorado of the West", generally referring to the Green River Basin, Wyoming. Nuttall travelled in the Wyeth Expedition that followed a route north and west of the Great Divide Basin. Nuttall's collection represented the first discovery of the species, later documented in east-central Idaho, the southwestern edge of the Salt Lake Desert in western Juab and Tooele counties, Utah, and in the Spring Valley area of southern White Pine County, Nevada. This species is ranked "G2" (globally imperiled), and in Wyoming is now ranked "S1" (critically imperiled). It was previously ranked as historical in the state ("SH"; Heidel 2003).



Above: *Astragalus diversifolius* (meadow milkvetch). From: Hitchcock, E.L., A. Cronquist, M. Ownbey and J.W. Thompson. 1961. *Vascular Plants of the Pacific Northwest*. University of Washington Press, Seattle, WA.

Note: *Astragalus diversifolius* differs from *A. convallarius* in having pods that are 10-17 mm long as compared to 20-50 mm long, and leaflets often broader than linear. It is prostrate or diffuse while the latter is ascending or diffuse. It is also restricted to alkaline meadow habitat (from Barneby 1989).

Pale blue-eyed grass (*Sisyrinchium pallidum*) was collected in rich meadows in central areas of Chain Lakes (*Heidel 2926, 2940* RM). It represents a first record for Sweetwater County, and was previously known from Albany and Carbon counties including recent collections made in the Great Divide Basin of Carbon County (*Fertig 19263, 19141* RM). It is also present in north-central Colorado (Moore and Friedley 2004).

Tiny phacelia (*Phacelia tetramera*) and Red poverty-weed (*Monolepis pusilla*) are diminutive annuals that were collected together and separate

(Continued on p. 11)

(*Playa Plants* – continued from p. 10)

on "mud-spring" mounds in central areas of Chain Lakes (*Heidel 2917, 2918* RM; respectively). These collections represent the third and sixth recent collection locales of these species in Wyoming, respectively. The two species are also present in other Great Basin states.

Chain Lakes is a checkerboard of federal lands managed by Bureau of Land Management (BLM), and lands conveyed to the State, managed by Wyoming Game and Fish Department; collectively designated as the Chain Lake Wildlife Habitat Management Area. It lies at the eastern end of Sweetwater County, Wyoming. Chain Lakes became a sensitive species study area in 2007 as a joint project of the BLM and Wyoming Natural Diversity Database. Multi-stemmed beeplant (*Cleome multicaulis*) is the only Wyoming BLM sensitive species known to occupy alkaline meadows, and was a study target though not known from the area. To make a long story short, *Cleome multicaulis* is not present in Chain Lakes, but the four aforementioned Wyoming species of concern were documented.

The first discovery of *Astragalus diversifolius* was by Thomas Nuttall on the Wyeth Expedition of 1834 that traveled from Independence, MO to Fort Vancouver, WA. John Kirk Townsend, ornithologist, traveled with Nuttall on the Wyeth Expedition, and his observations of Nuttall offer a commentary on the person and on botanical sensibility in general:

> "*Throughout the whole of our long journey, I have had constantly to admire the ardor and perfect indefatigability with which he has devoted himself to the grand object of his tour. No difficulty, no danger, no fatigue has ever daunted him, and he finds his rich reward in the addition of nearly a thousand new species of American plants, which he has been enabled to make to the already teeming flora of our vast continent.*" (Townsend 1999, reprinted from Williams 2003).

Robert Dorn , in his first edition of "Vascular Plants of Wyoming" , dedicated the work to Thomas Nuttall, the first botanist to enter and cross Wyoming, "whose botanical perception and expertise were unmatched by any other American taxonomist of the nineteenth century" (Dorn 1977).

Botanists have yet to find *Astragalus diversifolius* in the Green River Basin as collected by Nuttall. But at last we realize that this living piece of his "grand object" is surviving and thriving in the state.

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For a humorous biographic sketch of Thomas Nuttall, see Markow (1999). For an insightful, extended biography, see Williams (2003).

The Chain Lakes survey was conducted to provide baseline sensitive species information for the Wyoming BLM, a joint project of the BLM and the Wyoming Natural Diversity Database.

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